TITLE OF INVENTION: "Safety Toe-Sensor for Lift Table"

INVENTOR(S): Robert M. Stone

ATTORNEY: Antonio R. Durando
Registration No.' 28,409

Antonio R. Durando
Quarles & Brady Streich Lang LLP
One South Church Avenue, Suite 1700
Tucson, AZ 85701

CUSTOMER NO.: 34282

ATTORNEY DOCKET NO.: 5037.046

SAFETY TOE-SENSOR FOR LIFT TABLE

RELATED APPLICATIONS

[0001] This application is a continuation-in-part application of Ser. Number 09/432,525, filed 11/3/99.

BACKGROUND OF THE INVENTION

Field of the Invention

[0002] The invention relates generally to safety mechanisms for load elevators; in particular, it relates to toe sensors for lift tables.

Description of the Prior Art

[0003] A typical lift-table configuration includes a load platform extendibly supported by two pairs of legs. The two pairs are located at opposite sides of the platform, and the legs of each pair are pivotally connected to one another at the centers of the legs. Each pair of legs thus forms a scissors-like assembly. The upper end of one leg of each pair is hinged to the platform while the upper end of the other leg has a roller movable along the platform. The bottom ends of the legs are similarly mounted on a base which may be movable or anchored to the floor of a warehouse facility. An appropriate electric,

pneumatic or hydraulic lifting mechanism is used to raise and lower the platform of the lift table.

[0004] Low-profile lift tables are favored in commercial applications because of the need to minimize the height of ramps used to place loads over them. In addition, because many loads consist of palletized boxes stacked above shoulders' height, a low profile advantageously facilitates their handling by workers while reaching for loads placed on top. Therefore, it is very desirable that a lift table be capable of compressing to the point where its platform is only a few inches above ground floor. Currently, most commercial lift tables are about 18 cm high (about 7 inches) when completely lowered, some low-profile models being as low as 5 cm (about 2 inches). Since the scissor assembly and the lifting mechanism of a lift table are normally fully contained within the base under the platform, a low profile can only be achieved by having the platform overlap and protrude downward over the edges of the base, so that the platform's structure becomes substantially coextensive with the base. Thus, a safety hazard is created by the platform closing in on the base as the lift table is lowered to its lowest point.

[0005] Safety standards vary from country to country, but most jurisdictions mandate that a predetermined clearance be

maintained between the platform and the base of a lift table in order to prevent foot injuries. Since a lift-table user is likely to be standing on its side loading and unloading packages, it would be normal for him or her to extend a leg close to or under the platform to gain more stability. Under such circumstances, it is also likely that a foot may be rested against or over the edge of the base, thereby placing the person at risk while the platform is being lowered toward the base.

[0006] In order to prevent this hazardous condition, U.S. ANSI Standards prescribe the use of toe sensors mounted along the underside of the platform's perimeter such that, when an obstruction is met during descent, the lift will be brought to rest before entrapment can occur, whether the lift is loaded or empty, and movement will not be restored until the obstruction is removed. Any unguarded horizontal clearance between the toe sensor and the underside perimeter of the platform must be limited to 22 millimeters (about 7/8 inches). Similarly, European Community standards require a vertical clearance of the platform over the floor of 120 mm (about 5 inches) and a horizontal extension of the platform beyond the base of 150 mm (about six inches) if no toe sensors or barriers are used. When a lift is equipped with a contact-activated device fitted to the

outer edge of the platform, this cannot be more than 8 mm (about 3/8 inches) from the outer surface of the device.

[0007] As a result of these safety standards, lift-table manufacturers have focused on equipping their products with perimeter toe sensors mounted along the outer edge of the platform. Most products utilize switches actuated by vertical guards that slide upward and de-energize the mechanism controlling the descent of the platform upon contact with an underlying obstacle. Some models utilize pressure-sensitive switches that are actuated by contact with the obstacle. Such switches are available in a variety of forms, such as the Controflex® electric tape switch sold by Tapeswitch Corporation of Farmingdale, New York, and the optic-electronic fiber Lightspeed® available from Southworth Products Corporation of Portland, Maine. This solution to the problem is undesirable because it still makes it possible for a lift operator to rest his/her foot over the edge of the base with no safety response until the toe guard (or other similar device) attached under the descending platform contacts the foot and disables the system. Because of the response time involved, by then it may be too late to prevent some degree of injury.

[0008] Another approach, based primarily on compliance with European standards, has been to build larger than necessary platforms to provide the prescribed clearances. This alternative is also undesirable because it requires a structural configuration that is unrelated to functional design criteria, which in some cases may be unacceptable for a particular application. For example, it may important to be able to distribute the load uniformly over the platform of a lift table, but that may be difficult to achieve with a relatively large platform that extends six inches beyond the base on all sides. Similarly, the lever arm resulting from the six-inch extension tends to render the lift unstable. Moreover, the vertical clearance requirement limits the minimum height of an overhanging platform to about five inches, which is higher than desirable and otherwise attainable for many applications.

[0009] Simpler but less effective solutions have been implemented by using disabling pressure-sensitive mats and/or protective guards around the perimeter of the lift table to prevent encroachment by the operator. The former approach also prevents productive utilization of valuable space around the lift table; and the latter requires the addition of often cumbersome and expensive guard structure to the base of the lift table. Therefore, neither solution is desirable. Accordingly, there is

still a need for a better solution in preventing injuries caused by the descending platform of a lift table.

SUMMARY OF THE INVENTION

[0010] A goal of this invention is a lift table that includes a safety device to prevent a user's foot from protruding under the platform and suffering injuries as the platform is lowered to its ground position over the base.

[0012] Another objective of the invention is a safety mechanism that is actuated by a dangerous condition prior to contact with the descending platform of the lift table.

[0013] Another goal of the invention is a safety mechanism that can be implemented within the requirements of all current safety standards for lift tables.

[0014] Still another objective is a safety mechanism in the form of a toe sensor that can be implemented in the base of the lift table, rather than its platform, thereby facilitating the realization of an overall very low profile configuration.

[0015] A final objective is the realization of the above mentioned goals in an economical and commercially viable manner. This is done by utilizing simple components that are either

already available commercially or that can be produced competitively during the manufacture of the lift table.

[0016] Therefore, according to these and other objectives, the present invention consists of a lift table that includes a disabling toe sensor responsive to contact around the entire perimeter of the base. Multiple pressure switches are installed over two sides of the base and capped by an overlapping four-sided suspended cover. Multiple guides and springs of appropriate stiffness support the cover in free-floating arrangement over the base, so that any detectable pressure exerted on the cover causes the compression of the springs and the direct application of pressure on an underlying switch which, in turn, de-energizes the mechanism powering the descent of the platform. The pressure switches are incorporated into a control circuit that is activated only when the platform is descending. The platform may be sized to match the base or extend over the base and overlap the cover of the toe-sensor mechanism.

[0017] As a result of this design, the descending motion of the platform is automatically stopped as soon as pressure is exerted on the cover of the invention by a foot or other obstacle that is either resting on top of the cover or leaning against its side. Because of the negligible horizontal clearance between the

platform and the cover of the toe sensor, any obstacle sufficiently removed from the cover to prevent the actuation of the pressure sensors would also be unaffected by the complete descent of the platform. On the other hand, any obstacle within reach of the platform would cause its arrest by contacting the toe sensor prior to connecting with the platform. Moreover, this design makes it possible to lower the profile of the lift table to the fullest extent allowed by the size of the various components, with no extra space required for arbitrary safety clearances.

[0018] Various other purposes and advantages of the invention will become clear from its description in the specification that follows and from the novel features particularly pointed out in the appended claims. Therefore, to the accomplishment of the objectives described above, this invention consists of the features hereinafter illustrated in the drawings, fully described in the detailed description of the preferred embodiment and particularly pointed out in the claims. However, such drawings and description disclose only one of the various ways in which the invention may be practiced.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019] Fig. 1 is a perspective view of a conventional lift table modified according to the invention by the incorporation of a toe sensor within the base of the unit.

[0020] Fig. 2 is a perspective view of the base of the lift table of Fig. 1 prior to modification according to the invention.

[0021] Fig. 3 is a perspective view of the base of the lift table of Fig. 1 including perimeter pressure switches and toe-sensor-cover support springs according to the invention.

[0022] Fig. 4 is a cross-sectional view of the base of Fig. 3, as seen from line 4-4 in that figure, showing a pressure switch of the invention.

[0023] Fig. 5 is the cross-sectional view of Fig. 4, further illustrating a support spring of the invention.

[0024] Fig. 6 is the cross-sectional view of Fig. 5, further illustrating the cover of the invention, as would be seen in part from line 6-6 in Fig. 1.

[0025] Fig. 7 is a perspective view of the base of the lift table of Fig. 1 including the toe-sensor cover of the invention.

[0026] Fig. 8 is a perspective view of the toe-sensor cover of the invention.

[0027] Fig. 9 is cross-sectional view of the cover of the invention as seen from line 9-9 in Fig. 8.

[0028] Fig. 10 is a top view of the base of the lift table according to the invention without the switch guard.

[0029] Fig. 11 is a top view of the base of the invention illustrating a foot stepping on one of its ends.

[0030] Fig. 12 is a schematic diagram of the electrical circuit including the safety switches of the invention.

[0031] Fig. 13 is a perspective view of another embodiment of the invention, wherein the toe sensor is implemented with non-contact perimeter beam sensors.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0032] This invention is based on the idea of providing a toe-sensor mechanism in the fixed base of the lift table rather than in the moving platform, as previously done in the art. The approach simplifies the implementation of the toe-sensor function and minimizes the additional space required for compliance with safety standards.

[0033] Referring to the figures, wherein like parts are designated throughout by like reference numerals and symbols, Fig. 1 illustrates in perspective view a load elevator or lift table 10 according to the invention. In conventional manner, the lift table 10 includes a horizontal platform 12 for supporting loads, a scissor assembly 14, a ground base 16 (which may be anchored to the floor), and a motor or equivalent mechanism 18 with appropriate electrical and hydraulic hardware for actuating the scissor assembly and elevating or lowering the platform. The inventive part of the lift table 10 resides in a toe sensor 20 incorporated into the base 16.

[0034] As illustrated in isolation in the perspective view in Fig. 2, the base 16 consists of a rectangular support structure

defined by two C-channel side beams 22 and two angle end bars 24. The scissor assembly 14 and the power unit 18 (only shown in Fig. 1) are anchored in conventional manner to the base 16. As shown in the perspective and cross-sectional views of Figs. 3 and 4, multiple pressure switches 26 are mounted, preferably on a support plate 28, along the length of the side beams 22 and are connected to the lift table's control circuitry, as detailed below, such that any appreciable degree of pressure exerted on any one switch 26 causes the deactivation of the system that controls the descent of the platform. Appropriate wiring 30 strung around the frame 16 is used to connect the switches 26 and to link them to the control circuitry of the lift table.

[0035] As seen in Figs. 3 and 5, the toe sensor of the invention further includes a plurality of conical springs 32 mounted on the support plates 28 in line with the switches 26 and distributed over the length of the side beams 22. The springs 32 are provided to support a cover or guard 34 suspended substantially in free-floating arrangement over the base, as illustrated in cross-sectional and perspective views in Figs. 6 and 7. The switch guard 34 consists of a rectangular structure with L-shaped angle sides 36 and straight vertical ends 38 sized to overlap and snugly fit around the base 16 (see Figs. 8 and 9). Thus, the guard 34 can be seated over the base 16 resting on the springs 32

with side lips 40 slightly extending over and overlapping the side beams 22, as seen in the cross-section of Fig. 6. It is important that the guard 34 be loosely coupled to the base 16, so that it can slide vertically along its side beams 22 and end bars 24 when a force is applied to it, but not be so large as to materially increase the size of the base.

[0036] In order to provide horizontal stability of the guard 34 in relation to the base 16, the ends 38 of the guard contain vertical slots 42 suitable for slidable connection with retaining cap screws 44 attached to the outer surface of the end bars 24 of the base 16 (Figs. 3 and 7). In the preferred embodiment of the invention, I found that four pressure switches 26 located near the corners of the base 16, as illustrated clearly in the top view of the base in Fig. 10, are sufficient to provide the sensitivity to pressure necessary to de-energize the power system of the lift table whenever the guard 34 is touched by an encroaching object. For example, when the foot F of an operator steps over any part of the guard 34, as illustrated in Fig. 11, the springs 32 readily collapse to allow pressure to be exerted on at least one switch 26 and interrupt the descent of the platform 12.

[0037] The preferred switch used for the invention is marketed by Tapeswitch Corporation under the name Ribbon Switch, which is suitable for connection between a power source and a load. Ribbon Switches are normally closed between the power source and the load and are shorted by the application of pressure, thereby opening the circuit connection to the load. As such, the control aspect of the invention can be implemented simply by wiring the switches 26 in parallel (although they appear installed in series on the base 16) in the down-cycle circuitry of the lift table, as illustrated schematically in Fig. 12. It is noted that the descent of the platform 12 of a lift table is typically effected through an open valve V that controls the release of hydraulic fluid from a support ram. Whenever one of the switches 26 is short-circuited by the application of pressure exerted through the guard 34, the down-cycle circuit is opened, and the solenoid S is deenergized, thereby closing the valve V which controls the descent of the platform.

[0038] I also found that four conical springs 32, one placed approximately next to each pressure switch 26, are suitable for supporting the guard 34 of the invention about 6 mm (1/4 inches) above the switches, so that minimal contact with the guard is sufficient to trigger at least one of the switches. For a guard 26 weighing about 10 kg (approximately 12 pounds), springs with a

spring rate of about 1.1 kg/cm (approximately 6 lb/inch) have been found to be adequate. With these component characteristics, a threshold force of about 1-2 Kg (approximately 2-4 lb) applied anywhere to the guard 34 has been found to suffice to trigger the toe sensor of the invention (the exact force of course depending on the location where the force is applied and the corresponding lever arm resulting from the guard 26). The thickness of the plate 28 can be used advantageously to adjust the gap between the bottom of the guard 34 and the top of the switches 26 to obtain the desired pressure sensitivity. Four cap screws 44 placed on the end bars 24 near the corners of the base with corresponding slots 42 in the guard have also been found to adequately retain the guard in place while suspended over the base.

[0039] Thus, the present invention provides an effective mechanism for preventing injuries cause by the descending platform of a lift table. The invention is implemented in the base of the lift table, rather than in the platform, and without material modification to the conventional configuration of the base. The toe sensor of the invention meets all safety standards currently in effect without noticeable increase in the dimensions of the lift-table's platform and base. Moreover, it can be implemented with relatively inexpensive additional components.

[0040] It is noted that the main aspect of the invention resides in the incorporation of a contact toe-sensor in the base of the lift table. Accordingly, while the preferred embodiment has been described in terms of pressure switches mounted around the base, the concept of the invention can be implemented in equivalent fashion utilizing different kinds of switches, such as, without limitation, Hall-effect, limit, and optic-electronic fiber switches. The essence of the invention is to couple a sensor to the base of the lift table so that any intruding object is detected and the descent of the platform immediately arrested. To that end, as illustrated in Fig. 13, non-contact perimeter beam-sensors 46 can be used in equivalent fashion to practice the invention. A photoelectric, infrared, ultrasound or other equivalent radiation emitter 48 is utilized to provide a beam (illustrated as B in the figure) that is appropriately reflected by mirrors 50 around the perimeter of the base 16 toward a receiver 52. When the beam is interrupted by an encroaching object, the descent of the platform 12 is stopped, as taught by this disclosure.

[0041] Thus, while the present invention is described with reference to particular embodiments, those skilled in the art will recognize that many variations and geometries may be

employed without departing from the spirit and scope of the invention as set forth in the claims.